INTERNATIONAL RICE COMMISSION

NEWS LETTER

Issued by the I.R.C. Secretariat, c/o FAO Regional Office, Bangkok, Thailand.

No. 9 March, 1954

A COOPERATIVE PROGRAM FOR RICE IMPROVEMENT IN THE PHILIPPINES[1]

by

H.K. Hayes[2]

THERE has been a gradual increase in financial support and facilities for agricultural research in the Philippines since the time of Liberation from the last war. Local personnel of research staffs in the Bureau of Plant Industry, Department of Agriculture and Natural Resources, the Central Experiment Station of the College of Agriculture, University of the Philippines and other agencies have returned to their normal activities. Supplemental financial and other aid has been made available from the FOA-Philcusa program to the Bureau of Plant Industry and to the College of Agriculture. The Cornell-Los Banos contract at the College of Agriculture, supported by FOA, has the major purpose of aiding the development of more intensive agricultural research.

The reason for this note is to outline the present status of cooperative research on rice improvement between the College of Agriculture at Los Banos and the Bureau of Plant Industry, Department of Agriculture and Natural Resources.

The Central Experiment Station is located at Los Banos about 45 miles from Manila, where somewhat adequate facilities

1 *Contribution from the Central Experiment Station, College of Agriculture, University of the Philippines.*

2 *Professor of Plant Breeding, Cornell University and College of Agriculture, University of the Philippines.*

for intensive phases of plant breeding are being developed. The Bureau of Plant Industry has very limited field facilities at its central offices in Manila, considerable equipment at this Central Office for carrying out laboratory phases of rice improvement, and outlying stations in various regions of the Islands where seed increases and varietal improvement studies are being conducted. It seems evident that a coordinated and cooperative program of rice improvement should result in more rapid progress in both basic knowledge and in carrying the fruits of research to the grower and consumer.

The present plan of work was organized after making a survey of the present status of improvement studies and by mutual exchange of viewpoints by leaders in the Bureau of Plant Industry and at College. The original field plans and other details of procedure were drawn by the these leaders.

RICE AND CORN IMPROVEMENT TRAINING SCHOOL.

Interest and knowledge of the nature of the program was fostered by a five-day training school in rice and corn improvement held at University of the Philippines, College of Agriculture, Los Banos in 1953 from May 18th to 22nd, inclusive. Forty-five persons attended all days and a total of 112 different people registered for one or more days. Those in attendance included personnel from the Los Banos Agricultural College, the Bureaus of Plant Industry, Soil Conservation and Extension of the Department of Agriculture and Natural Resources, the Central Luzon Agricultural College and several high schools. The attendance included administrative leaders and subject-matter specialists in different fields including Plant Breeding, Agronomy, Plant Pathology, Entomology, Soils, Agricultural Engineering, Agricultural Economics, and Extension. This opportunity for exchange of viewpoints was very helpful.

THE COOPERATIVE RICE IMPROVEMENT PROJECT.

Specific field plans for cooperative researches were drawn up at College, by leaders from the Bureau of Plant Industry and College of Agriculture and were furnished cooperators. A large part of the success of the program resulted from the interest and careful work of local cooperators at the different field stations. Whenever possible, leaders from College and from the Buerau were present to supervise the initiation of the program at the time the field work was started at each station.

With the beginning of the wet season in 1953 a cooperative rice improvement program was organized. The work is being carried out with both upland and lowland varieties of rice. The major work this year consists of varietal trials, an observational nursery of a considerable number of selections of lowland rice at the Maligaya Rice Experiment Station, a similar nursery of upland rice at College, Los Banos and breeding nurseries with relation to lowland rice at College. In addition to these phases, the two cooperating agencies are making head selections in all varieties in the yield trials. These will be used for purification of desirable varieties during the next crop

season. A brief report will be made of three of these phases.

Lowland rice variety trials. Varietal tests of lowland rice have been nearly completed. The tests at Maligaya and College (near Calamba) include 107 different varieties. Two of these varieties are being grown as checks and the tests are being made by dividing the varieties into different maturity groups of approximately 20 varieties in a group including the two checks in each group. Three replications of each plot were made with rows six to ten meters long. A third large trial including about the same number of varieties has been planted at the Camarines Sur Agricultural High School at Pili. A smaller trial of 30 varieties is being made at the San Carlos Agricultural High School in Pangasinan, and plans have been completed for a trial at the Trinidad Agricultural High School in Mountain Province which will be transplanted on or about the middle of February, 1954.

Upland rice variety trials. Upland rice variety trials are being made at College, Economic Garden, Maligaya, Lamao, Isabela, on the island of Luzon; at Aroman, on the island of Mindanao, and at La Carlota on Occidental Negros. A similar plan is being used at each of these locations. Eighty-six varieties are under trial which are being conducted in about the same plan as with the lowland variety trials. For the upland varieties the tests are being carried out in four groups of approximately 20 varieties for each group and with two common checks in each one of the groups. Two of the four replications were planted in drills and the other two in hills. The results of these studies have been summarized and according to present plans cooperators will meet early in March 1954 to study data and plan the next season's program.

Observational trials. The observational trials of upland rice at College include 190 different varieties and selections. These were planted at several different dates in short rows and data has been obtained regarding various characters to be used as a possible source of desirable germ plasm. Particular studies have been made by the various cooperators in Plant Pathology and Entomology to find sources of resistance to insect pests and pathogenic diseases. The nurseries have been used also for studies of economic characters. More recently a rather complete list of varieties resistant to lodging and to diseases and insect pests has been drawn up from the FAO list of world genetic stocks and requests for seed sent to other rice workers.

A similar observational nursery for lowland rice which is being grown at Maligaya consists of a little over 300 different strains. This material is handled in much the same way as the upland observational nursery and checks of standard varieties are grown frequently throughout the nurseries.

Breeding nurseries. Rather extensive breeding nurseries of F_2 progenies have been grown of crosses made by the Central Rice Research Institute in Cuttack, India. These will be used to determine possibilities of selecting combinations of good characters of Philippine varieties of *indica* from both upland and lowland types with desirable

characters of *japonica* origin. Those crosses of interest from the standpoint of upland rice were planted in individual plant plots at College with standard varieties planted at frequent intervals throughout the nursery. A similar plan was followed for lowland rice at the Maligaya Rice Experiment Station. The crosses under study were made between leading Philippine varieties with selected varieties and strains of *japonica*. The pedigree method of breeding will be followed in carrying out this work.

RICE PRODUCTION AND IMPROVEMENT IN TAIWAN

(Condensed from the paper read before the Eighth Pacific Science Congress held at Manila, Philippines, in November, 1953).

by

T. H. Shen[1] and **Peter Kung**[2]

Taiwan is a subtropical island. It has high temperature, heavy rainfall, and frequent strong winds. The center of the island is mountainous aud alluvial plains are found along the coast. As of 1952, it has 876,000 hectares of cultivated land, of which 54.5 per cent or 478,000 hectares are used for growing rice. Rice is the principal crop all over the island, but sweet potato, sugar-cane, peanut, jute, tobacco, tea, banana, pineapple, citrus. casava, wheat and sisal are also important products in different regions.

The average annual production of rice in the period of 1935-39, the peak years under the Japanese occupation, was 1,339,494 metric tons of brown rice,[3] The production greatly declined during World War II, but has gradually picked up in postwar years. Thus there was recorded an all-time high of 1,421,486 metric tons of brown rice in 1950; 1,484,792 in 1951; 1,570,115 in 1952; and 1,640,000 (estimated) in 1953. The yield of rice per hectare has also increased.

Two crops of rice annually are normal in the irrigated areas throughout Taiwan. In 1952, including both paddy and upland rice, there were 785,729 hectares of rice harvested from 478,000 hectares of land devoted to rice, which means a ratio of 1.64 to 1 between the crop area harvested and the rice land area. The yield of rice per hectare in 1952 was 2,063 kilograms of brown rice. If the yield should be considered on an annual basis per hectare of rice land (including both crops), the per hectare yield in 1952 would have been almost doubled.

---

1. *Member of China-United States Joint Commission on Rural Reconstruction, Taipei, Taiwan.*
2. *Senior Specialist of China-United States Joint Commission on Rural Reconstruction, Taipei, Taiwan.*
3. *Brown rice weight x 1.31 = Paddy rice weight,*

Besides meeting the home consumption of almost 10 million people, Taiwan exported 95,475 metric tons of brown rice in 1952. Based on results obtained in the last few years, the government has set a goal of rice production for 1956 at 1.85 million metric tons largely by increasing yield per hectare.

This paper will deal with essential lines of rice improvement.

RICE-GROWING PERIODS AND CROP SYSTEMS

Rice-growing periods in Taiwan vary with varieties and districts. In irrigated regions two crops of rice a year are harvested. The first crop is transplanted from January to March and harvested from May to July. The second crop is transplanted from late June to August and harvested from late September to early December. The time of transplanting and harvesting is earlier in the south than in the north. In the northern part of Taiwan fields generally lie fallow during the winter. In the southern and central parts of Taiwan a green manure crop such as sesbania is often grown, being interplanted in the rice fields from May to early June and plowed under the late July to August before transplanting the second crop of rice, and the winter crop after the second rice crop is also often a green manure crop, though in some districts sweet potatoes, tobacco, wheat, vegetables, flax or corn are grown. It is in this way that three or four crops per annum are grown on the island.

Non-irrigated districts grow yearly a single rice crop during the rainy summer -transplanting in May and June and harvesting in September and October—and it is followed by peanuts, sweet potatoes, vegetables or green manure crops. In partially irrigated areas such as the Chia-nan Canal irrigation district in Tainan where there is not enough water to irrigate the 150,000 hectares, a three-year rotation system is adopted so as to grow 50,000 hectares each of rice, sugar cane, and sweet potatoes, or other crops.

The acreage and production of the second rice crop are higher than those of the first crop, but the unit yield of the first crop is higher because its growing period is 15 to 20 days longer.

There are both merits and demerits in such a crop system. In case of a disaster caused by typhoon, excessive drought, disease or insect pest, the partial or total loss of one crop can be partly made up by the other crops of rice in the same year. As the rice continue to be harvested from April to December from south to north, the period of rice shortage on the consumption market is shortened. Under such a crop system, rice farmers have to work the whole year round. In the double rice crop area, a double amount of fertilizers, irrigation water, rice seeds, and pesticides has to be provided yearly. But the investments made by the farmers are returned to them in a shorter period of time.

WATER AND FERTILIZER

Water and fertilizer are the two major factors contributing to the high production of rice and other crops on the island. Since the returning of Taiwan to China in 1945, the area of irrigated paddy land had increased by 62,206 hectares by the end of

1952. The total irrigated area now is 540,000 hectares, which is 65 per cent of all the cultivated land. The 1953 plan calls for the increase of the irrigated area by 4,719 hectares, and the improvement of existing irrigation systems covering 11,299 hectares of farm land. Possible additional area capable of irrigation is estimated at 120,000 hectares.

Based on the 118 field tests made in different districts,* the soils of the island are decidedly deficient in nitrogen. The phosphoric acid deficiency comes next and potash last of all. The soils need nitrogen in the first rice crop more acutely than in the second; their need for phosphoric acid is of about equal urgency for both crops; their need for potash is more acute in the second rice crop than in the first. This is true of both the Native and Ponlai varieties of rice. The application of nitrogenous fertilizer will increase the yield 10-30 per cent for the first rice crop and 10-20 per cent for the second. The application of phosphoric and potash fertilizers will increase the yield up to 10 per cent and they will be more effective in the second rice crop than in the first, particularly in the case of potash. With an optimum application ratio of N, P_2O_5 and K_2O there may be an increase of from 26 to 32 per cent for the first and second crops of Native rice, respectively, and of from 30 to 32 per cent for Ponlai. The optimum ratio of N, P_2O_5 and K_2O is 110:45:35 kg./ha. for the first crop of Ponlai varieties and 110:50:45 kg./ha. for the second crop; 110:45:40 kg./ha. for the first crop of the Native varieties and 90:35:50 kg./ha. for the second crop. The figures for the Native rice just referred to are based on experiments obtained in the Hsinchu district only.

As the chemical fertilizers used in Taiwan are largely imported, the amount used has been less than optimum. Based on the available amount of fertilizer in 1952, which was the largest since 1945, N, P_2O_5 and K_2O consumption was 65.7:24.4: 10.1 kg./ha. for the first rice crop and 69.7:26.2:-10.3 kg./ha. for the second. The total consumption of fertilizer for rice in 1952 was as follows:

Rice 1952	Acreage ha.	Production of Brown Rice M.T.	Fertilizer Consumption M.T.	Element Contents M.T.		
				N	P_2O_5	K_2O
First Crop	348,718	757,289	156,020	22,476	8,327	3,432
Second Crop	437,011	812,826	205,603	28,301	10,595	4,284
Total	785,729	1,570,115	361,623	50,777	18,922	7,716

In addition to chemical fertilizers, the amount of compost manure has been increased by encouraging hog production and reparing farmers' compost houses since 1950. The hog population has been increased from 1,362,159 in 1949 to 2,713,985 by the end of 1952. Up to June 1953, the China-United States Joint Commission on

* H.F. Chu: *A Resume of the Field Fertilizer Experiments on Rice & Sugar in Taiwan. Soils & Fertilizers in Taiwan, 1952. pp. 13—15.*

Rural Reconstruction (abbreviated as JCRR), the Provincial Food Bureau and the Provincial Department of Agriculture and Forestry have jointly helped 60,858 poor farmers repair their compost houses with a subsidy of about US$15.00 (for the purchase of cement) to each farmer. The poor farmers repaired their compost houses with such subsidy, but many well-to-do farmers were induced to repair their compost houses out of their own resources. According to a survey by the Department of Agriculture and Forestry there are about 360,000 compost houses on the island. One-third are in good condition, but the rest need repair. Currently, Taiwan produces about 8,000,000 M.T. of compost, a considerable portion of which is produced outdoors. According to a conservative estimate, the nutrients contained in 1,000 M.T. of well-made compost are equivalent in amount to 10 M.T. of ammonium sulphate, 5 M.T. of calcium superphosphate and 7 M.T. of potassium sulphate. Thus 8,000,000 tons of compost are therefore equivalent to about 80,000 M.T. of ammonium sulphate, 40,000 M.T. of calcium superphosphate, and 56,000 M.T. of potassium sulphate. If the 360,000 compost houses can all be repaired and fully utilized, each house may be expected to produce 40 M.T. of compost a year, and the total annual production will be 14,400,000 M.T., equivalent to 144,000 M.T. of ammonium sulphate, 72,000 M.T. of calcium superphoshate, and and 100,800 M.T. of potassium sulphate, in addition to the large amount of organic matter turned back to the soil.

Repair and construction of night soil pits for better utilization and preservation of nitrogen, and for sanitation purposes on farms and in cities has been carried out since 1952 by following similar methods used in the repair and contruction of compost houses.

The production of green manure crops is being increased by the multiplication and extension of their seeds.

The application of lime in red and yellow earths, the chemical reaction of which is around pH 4.5, has been demonstrated with favourable response in rice production.

RICE VARIETIES

There are two sub-species of rice in Taiwan, "*indica*" and "*japonica*." They came from three sources. In the earliest times the aborigines brought in rice from southeastern Asia. The acreage today from these introductions is small and of little importance. About 1661, Chinese settlers introduced *indica* varieties from Fukien and Kwangtung provinces, China. Commercially they are called Native rice. About 1899, Japanese introduced *japonica* non-glutinous varieties from Japan. Commercially, they are known as Ponlai rice, which the Japanese call Horai. Glutinous rice was also introduced from China and it includes *indica* and *japonica* types. There is a small amount of upland rice introduced from Fukien and Kwangtung provinces, China.

Ponlai and Native rice furnish the staple food for the people; the glutinous rice supplies mostly the needs of the fermentation industry and is used in the manufacturing of pastries. The upland rice is of

an inferior quality and is consumed chiefly by the local growers.

Ponlai rice is the most important in Taiwan, the Native rice ranks second and the upland and glutinous rice are of little importance. In comparison with the Native rice, the kernel of Ponlai is short and broad, its cross section is nearly round, and it is more sticky when cooked. Ponlai varieties are higher in yield when grown in fertile soil, shorter in growing period, and better in milling and table qualities. Being not so sensitive to photoperiodism as *indica*, the same variety of Ponlai can be grown for the first and second crops, and the Ponlai varieties are adapted to wider areas than the Native. When the Native varieties adapted to the second crop are grown as the first crop, they will usually not head until the second crop season. The seedling stage of Ponlai in the seedbed should not be too long: the optimum period is 25 to 40 days for the first crop and 15 to 20 days for the second crop. The duration of Ponlai seedling grown in the seedbed has a close relation to the date of heading. When the seedling is too old at the time of transplanting, it will head earlier, tiller less, grow shorter, and yield a lower amount of rice. This physiological behavior is especially pronounced in the second crop. The optimum period of Native rice seedling in the seedbed is 50 to 60 days for the first crop and about 40 days for the second. Ponlai needs high soil-fertility and proper irrigation. The Native rice can stand poor fertility and shortage of water better than Ponlai. Ponlai is more susceptible to rice blast and borer than Native rice. Owing to less tillering, the distance between Ponlai plants should be smaller for better yield per hectare: the optimum distance is 22.7 cm. between hills, 4 to 5 plants per hill, and 26 cm. between rows. As Ponlai does not easily shatter, it has to be threshed with the foot-pedal thresher. The Native rice can be easily threshed by beating heads on beams in a wooden box. Ponlai has a stiff straw but, in case of a storm, may suffer greater loss. As the Native rice has a weak straw, farmers bend the plant down to the ground before maturity to avoid damage by storms. The Ponlai plants can be hardly bent down without breaking their stems, so that they usually suffer a greater loss in storms than the Native rice. The straw of Native rice is good for cattle feeding. Since the Japanese prefer Ponlai rice and pay a handsome price for it, it is the best for export to Japan.

Under the Japanese regime, the acreage devoted to Ponlai rice was about twice that devoted to the Native rice. After the returning of Taiwan to China, Ponlai rice dropped to 59 and 69 per cent of the Native rice acreage in 1946 and 1947, respectively. This was largely due to lack of fertilizer and irrigation and suspension of pure seed extension. Since 1950 the situation has been steadily improved and the Ponlai rice acreage has been gradually approaching its former record.

RICE BREEDING

Varieties of the *Japonica* type introduced by the Japanese into Taiwan from 1899-1920 were characterized by their low yield, limited adaptation and susceptibility to blast-

Japanese first crossed blast resistant lines from these introduced varieties with other Japanese varieties of good yield. Strains from these crosses were somewhat better than the parent varieties but still not so resistant to rice blast as the Native type. Native varieties in general were more resistant and a few almost immune. Crosses between Japanese or Ponlai with the Native varieties were made.

New fixed strains were selected from F_5, F_6 or even as late as F_{10}. These new strains were then put to a "productivity test" for six generations, i.e. two crops a year for three years. The productivity test in regions was divided into two groups. One group was treated with the normal amount of fertilizer and manure and another one with double the amount. The first group was sometimes further divided into two subgroups by differences in the number of seedlings per hill: (1) one seedling per hill and (2) five seedlings per hill. The area of each plot for a strain was $\frac{1}{400}$ ha. Each test had two replications. The notes that were taken on those tests included the following items: heading and maturity, percentage of blast and other diseases, height of plant, color of chaff, awn, shape of kernel, tillering, length of head, number of kernels per head, degree of sterility, yield of rice and straw, weight of rice per litre, weight of 1,000 rice kernels, percentage of brown rice, weight of brown rice per litre, weight of 1,000 brown rice kernels, and quality of rice.

The best selections obtained from these productivity tests were put to regional tests. Each test had three replications and was continued for three years. The best selections obtained from these tests were used in seed multiplication and extension.

Since the returning of Taiwan to China, the methods of rice breeding, especially in yield tests and regional tests, have been modified in accordance with the method used by the National Agricultural Research Bureau at Nanking. Since 1950 JCRR has cooperated with the Provincial Agricultural Research Institute to conduct regional tests at its eight stations. These tests cover 15 new strains of Ponlai from hybridization and a check variety Taichung 65. Randomized five-row plots are used with six replications. Each row is four meters long with a space of 25 cm. between rows, and has 20 hills with five seedlings per hill and a space of 20 cm. between hills. The plants in the three middle rows per plot are harvested for yield study.

The important varieties of Ponlai now grown are developed from hybridization. Varieties bred by the District Agricultural Improvement Station at Taichung as *Taichung* 65, 150, 153, *Glutinous* 46, and *Kwangfu* 401 are adapted to the whole island. Thus the island can be considered as one region of double-cropping rice. More varieties resistant to blast come from crossss of Ponlai with Native varieties. But the three most resistant varieties, Kwangfu 1, Kaohsiung 22 and 27, resulted from the crosses between Ponlai varieties. They are nearly as resistant as some of the Native varieties. This suggests the importance of testing the resistance of varieties and the choice of parents for crosses, which will be discussed under "Rice Blast."

Native Rice Breeding

There were 1,679 varieties of the Native rice in 1901. The Japanese made selections from these which were then put in a plant-to-row test for a year and to an inheritance test for another year to see if essential characters were fixed. Selections obtained from them were put in a productivity test for one year. Selections obtained from the productivity tests were put in a regional test. Through these tests about 390 varieties were finally selected for seed multiplication and extension. They were distributed according to their adaptation to the different regions and with regard to the particular crop (whether it be the first or second one) to be grown. In general, the Native varieties are adapted to a narrower region than Ponlai because the former are more sensitive to photoperiodism and because the same variety cannot be used for both the first and second crops.

Since 1950, JCRR in cooperation with the provincial experimental stations at Taipei, Taichung, and Kaohsiung has made about 58,060 head selections from some 300 Native varieties. They were put in a head-row test with a check every tenth row, single plant per hill and 25 hills per row, 2 meters in length and 1/3 meter between rows. Selections were based on field observation. They were put in a single row test in 1952 with systematic arrangement, two replications, and a check every fifth row. A row was 4 meters long, with a space of 25 cm. between rows. Based on field notes and yield, selections were made. They are now (1953) put in single row tests with five replications. Other arrangemets are similar to the two single-row tests. Selections obtained from the five rod-row test will be put in variety tests in 1954. For variety tests five-row plots are used in randomized blocks with five replications. There will be about 25 varieties in a group. Each group will include the same variety as check. Analysis of variance will be used for yield from the three middle rows per plot. The notes to be taken will be somewhat similar to those taken in the productivity test of Ponlai hybrid strains. Two sets of the variety test will be conducted by applying different amounts of fertilizer: one by applying the normal amount and another with double the amount in order to test the response of varieties to fertilizer with respect to yield, blast disease, lodging, etc. The variety test may be conducted for 2 or 3 years to be followed by regional tests. However, some regional tests of Native rice varieties have already been made. Based on farmers' requests and the area of varietal adaptation, JCRR selected some 30 better varieties of Native rice in 1950 for regional tests in eight places. They are now (1953) in the third year of those tests.

Since 1947, the National Agricultural Research Bureau of Nanking in cooperation with the Taiwan Provincial Agricultural Research Institute introduced some 38 rice varieties of *indica* and 8 of *japonica* from the mainland and conducted regional tests in Taiwan. As a result of those tests, the National Agricultural Research Bureau's No. 4 of *indica* type developed at Chengtu and Nanking has been proved superior to the Native varieties in Ilan and Lotung in the

northeastern part of Taiwan and is now used in demonstration and extension.

For the purification of the Native varieties, the district agricultural stations made a mass selection of the varieties in each district in 1949 as requested by the farmers. They were multiplied by seed farmers under contract in 1950 and 1951. Their seed extension began in 1952 with great success.

SEED MULTIPLICATION

The operation of seed renewing has long been recognised as a measure to obtain a good crop and was practised for many years by farmers in Taiwan. The farmers used to renew their seeds in every third or fourth crop. It created annually a great demand for pure seed of rice and needed a province-wide program on seed multiplication to meet the demand.

For Ponlai Rice

Work on seed multiplication of Ponlai rice on this island is divided into three categories: (1) multiplicaticn of foundation seed, (2) multiplication of stock seed, and (3) multiplication of extension seed. The whole program may be completed within one and a half years as the same variety of Ponlai rice will grow well in the first and second crops. The three categories of work are carried out in three kinds of seed farms, the number of which are about 8, 160 and 6,000 respectively in each crop season and the total acreage are 3 ha., 80 ha. and 3,000 ha. respectively.

The program has been carried out twice a year under the direction and supervision of the Taiwan Provincial Department of Agriculture and Forestry in cooperation with local governments and farmers' associations. The Provincial Agricultural Research Institute and the seven district agricultural improvement stations operate on the foundation seed farms, the township farmers' associations and a part of contracted seed growers manage the stock seed farms and the contracted farmers, the extension seed farms. The three kinds of seed farms are evenly distributed all over the island. Each village may have one extension seed farm operated by experienced growers with technical assistance from the township office and the township farmers' associations. Both the foundation and stock seeds are allocated free of charge to the stock and extension seed farms while the extension seed is distributed to general farmers in exchange for ordinary rice seeds at from equal rate to 20% premium. The increase of rice yield as a result of the renewal of seed has been conservatively estimated at 5 to 8%. At present, 12,000 metric tons of pure extension seed of 20 promising varieties of Ponlai rice are made available annually to renew the farmers' seed in sufficient quantities for planting 200,000 ha., about one half of the total Ponlai rice area.

For Native and Upland Rice

In the early stages of the seed multiplication project, emphasis was laid on Ponlai rice only. Multiplication work has been expanded to include Native rice since 1950 and upland rice since 1952.

As no improved varieties were available for either Native or upland rice, their multiplication work is carried out in a different

way from that for Ponlai rice: (1) Obtaining the original seed through mass selection of certain local popular varieties, (2) multiplication of primary seed, and (3) multiplication of secondary seed. The varieties of Native or upland rice being only suitable for either the first crop or the second crop and not for both crops, it will take three years to complete the whole multiplication project.

The number of primary and secondary seed farms of Native rice are 120 and 2,500 respectively in each season. In 1953, the first batch of pure seed of 70 varieties about 4,000 metric tons, (2,000 metric tons each for the first and second crops) are available for general extension. It is estimated that an acreage of 80,000 ha. will be covered.

The multiplication of upland rice is just started. Sufficient amounts of pure seeds of 25 varieties will be expected in 1955.

The Progress of Seed Multiplication in Recent Years

The system of rice seed multiplication, started in 1922, had contributed a great deal in the purification and promotion of rice production on this island. Unfortunately, due to lack of funds, facilities and technical personnel during and after World War II, the program had not been continued satisfactorily until the Joint Commission on Rural Reconstruction took up the rehabilitation and improvement work in 1949. A subsidy is provided to finance the foundation and stock seed farms in an amount of local currency equivalent to US$170 and US$27 per ha. respectively for each crop. But as the area of extension seed multiplication amounts to 3,000 ha. in case of Ponlai rice and the degree of extension seed purity is not so high as that of stock seed, the JCRR has introduced a system that the extension seed multiplication be on self-supporting basis instead of government subsidy. Rice growers are requested to pay 10-20 per cent premium in exchange of their own degenerated seed for extension seed. The premium is to pay the extra labour for multiplication of the extension seed. Prior to 1950 the extension seed had been exchanged with farmers' degenerated seed at equal rate and the government had given subsidy to the contracted farmers who multiplied the extension seed. Realizing the importance that the superior seed can only be produced from well equipped seed farms, the JCRR has given fund to all the seven dirtrict agricultural improvement stations for the repair or construction of seed storages, drying grounds, and compost houses and also helped to establish 23 new permanent stock seed farms with the establishment of drying and storage facilities and compost houses. A total of 6,110 farm-size concrete drying grounds, 971 storage huts and 644 steel bins were also constructed for the extension seed farms scattered all over the island.

Technicians of the district governments and township offices have received money from the JCRR for seed inspection trips. Besides, 303 bycicles were distributed free to the township offices for field trips.

At present most of the seed farms show high cooperating spirit and the local governments pay more attention to the program on rice seed multiplication. The

seed produced by the contracted farms has gradually acquired higher standard and can easily win the confidence of farmers.

By the encouragement of 10-20 per cent premium on seed-exchange and the JCRR subsidy for the construction of drying and storage facilities for the extension seed farms, the program is now on self-supporting and self-perpetuating basis.

RICE DISEASES AND INSECTS AND THEIR CONTROL

Loss of the rice crop from diseases and insects in Taiwan was estimated at 15% of the total production in 1952. Of these, 5% was attributable to the damage done by the blast disease caused by *Piricularia oryzae* Cav.; 5% to rice borers, chiefly *Schoenobius incertellus* Walker; and the remaining 5% to Hispa beetle, *Hispa similis* Uhm., leaf beetle, *Lema oryzae* Kuw., leaf-roller, *Cnaphalocrocis medinalis* Gue., leaf-hoppers, *Nilaparvata oryzae* mats., *Nephotettix bipunctatus* F. and *Sogata furcifera* Horvath, and other insects and diseases.

Rice Blast

The blast disease has usually developed much more seriously in the first crop than in the second, probably due to the cooler wheather during the first crop season. The varieties of Ponlai or *japonica* type are distinctly more susceptible to the blast than the Native rice. Nitrogenous fertilizers favour the development of the disease especially when the N-fertilizers are not applied in proper balance with K and P. The disease may be found in all rice-growing areas but often causes epidemics in regions where Ponlai varieties are concentrated and the fields are near the hillside. By experience, farmers do not grow the Ponlai varieties for the first crop in the Ilan plain, Puli, and other places close to the hills chiefly because of the prevalence of the disease in that season. The disease may develop at any stage in the growth of the rice plant, but outbreaks are often noticed in the late tillering stage, appearing as "leaf-blast", and in the heading stage, appearing as node-blast or neck-blast. The later form is often more detrimental.

Control of the blast disease depends, as a temporary measure, upon seed treatment and spraying with fungicide and, for permanent relief, upon the breeding of resistant varieties. During the past few years, the "New Improved Granosan", an organic mercury compound, has been found to be very effective and has been employed to treat the seeds. It has been also used to spray the seedbed and the fields against the "leaf-blast". During the past few years all seeds of the Ponlai varieties for the first crop were treated. They were treated on a community basis in small ponds built for such purposes with JCRR subsidies and also in wooden tubs made by individual farmers. The seed-treating program is to be extended also to include seeds of the Native varieties for the first crop, as the nitrogen fertilizers used in the rice field have been increased and thus cause more frequent outbreak of the blast disease of these Native varieties.

Varietal resistance to the rice blast was studied extensively in Taiwan by Y. Hashioka in 1937—47. About 400 varieties native to different regions and latitudes covering the

whole of Asia were tested with artificial inoculation in the greenhouse and in paddy fields. He found that in general most of the varieties native to the temperate regions are more susceptible than the tropical varieties, and this tendency is more marked in the adult plants than in the seedlings.[1] Ponlai and Japanese (lowland) varieties are most susceptible. Varieties from north and central mainland China are mostly susceptible. Those from China range all the way from sensitive susceptibility to strong resistance. Native varieties of Taiwan *(indica)* vary from medium susceptibility to immunity. In the crosses between temperate and tropical varieties, Hashioka finds that the inheritance of resistance is governed by two dominant genes. The physiological specialization of the causal fungus, as known, is not too complicated.

In recent years, Dr. S.H. Ou of JCRR has been coordinating and helping the studies on blast resistance of the Provincial Agricultural Research Institute at Taipei, the National Taiwan University, and other agricultural institutions. There were 931 new and old varieties, including promising strains from hybridizations, tested by artificial inoculation in the greenhouse and observed in the field in the course of 1950-53. Resistance of the extension varieties, including 44 of the Ponlai type and 1 of the Native type, serving as resistant check, was tested by Li Hsio-chien of the Provincial Agricultural Research Institute in cooperation with JCRR.

Other diseases

The Fusarial disease caused by ***Fusarium Fujikuroi*** Wor, and the Helminthosporium leaf spot caused by ***Ophiobolus Miyabeanus*** Ito and Kur. are quite common but seldom cause heavy losses. They havə also been effectively reduced by the "Granosan" seed treatment. Several sclerotial diseases caused by ***Sclerotium*** spp. damage the second rice crop in many localities, but the acreage affected has been usually small,

Rice Borer

The rice borer has long been a problem in rice culture in the Orient. So it is in Taiwan. Three species of rice borers are found in Taiwan but the paddy borer, ***Schoenobius incertellus*** Walker, is the most destructive. The paddy borer reproduces 4 to 5 generations in a year in the northern part of the island and 5 to 6 generations in the southern. Serious outbreaks often occur in the Tainan-Chiayi area because of the growth of the intermediate crop of rice and the upland rice which are planted all along from March to August and which serve as good hosts for the development of the borers. The rice borer causes heavy damage in the south but relatively light damage in the north. Because of the warm and dry weather, the mortality of the insects during winter has been very low in the south. The long absence of food supply between the first and second crops in the Pingtung area has somehow checked the development of the borers. The relatively cold temperature and frequent rainfall during winter have probably reduced the population in the north. When environmental conditions and

1 Yoshio Hashioka: Studies on the Machanism of Prevalence of the Rice Blast Disease in the Tropics. Technical Bulletin No. 8, Taiwan Agricultural Research Institute, Taipei, 1950, pp. 105-106, 153, 155, 188.

the stage of rice growth are the same, Ponlai varieties usually suffer more from the borers than Native varieties in the same area.

The control of rice borers has been difficult. Old methods are either ineffective or impractical. Recent methods developed under the leadership of Dr. S.H. Ou of JCRR for controlling the borers in Taiwan are: (1) to apply insecticides to protect the seedling throughout the seedbed stage and (2) to apply new systemic insecticides to fields where infestation still occurs from borers that have escaped the treatment in the seedbed stage. These methods were developed by studying the life cycle of the insects and were based on the fact that the average date for the emergence of the first generation of the paddy borer moths is earlier than the average date for the transplantation of rice. There is no other host for the borer than rice seedlings at that particular time. When the seedbeds are treated with insecticides, the majority of the borers will be killed upon contact with the seedlings. Infestation from the late-emerged moths which escape the seedbed treatment can be treated with the new systemic insecticides such as "Folidol." "Folidol" has been tested in Taiwan and, in high dilutions, found to be potent enough to kill the larvae inside the stems of the rice plants, especially in their early stages. DDT, dieldrin, Endrin, etc. may also be used for controlling larvae in the stem. From the experience of the first and second crops, 1953, these methods have proved very effective under Taiwan conditions. Supplementary measures such as collecting egg-masses and early plow-under of the rice stuble are also encouraged.

Other Insects

The rice Hispa beetle reproduces 4 generations a year in Taiwan. Serious outbreaks have occured in the past few years. Tens of thousands of hectares were infested, The leaf beetle occurs in many localities but has not caused very serious damage. The leaf-hopper usually causes more damage in the south, but heavy infestation over large areas has not been observed in the past few years. The leaf-rollers develop in many localities and often affect a considerable acreage. But usually they cause heavy damage only in the early stages of the rice plant. Control of these insects is technically simple. All of them can be effectively controlled by the application of DDT or BHC powder, which is now widely practised in the island after two years' demonstration conducted by the Provincial Department of Agriculture and Forestry and JCRR.

The control of "salt-water millipede", *Tylorphynchus chinensis* Crude, on 700 hectares in Ilan and of a species of earthworm on 200 hectares in Taichung are of particular interest. The former pest originated in the sea, became inhabitants in the soil, ate up all the organic matter and roots of rice plants and thus rendered the fertile field useless. People move away and villages were ruined. It was successfully controlled by the application of 500 kg. per hectare of tobacco wastes. The average yield of rice after treatment increased more than 200%. The earthworms damaged the fields by making numerous small tunnels to a depth

of 3 feet or more. Water and fertilizers leached away immediately and crop yield was greatly reduced. It was controlled by the use of 1,200—1,400 kg. of calcium cyanamide on each hectare. These fields have been restored to their normal productivity and the beneficent effects may remain for many years to come.

COORDINATION OF THE RICE PROGRAM

Since 1949 the government has laid great emphasis on rice production to feed the increasing population evacuated from the Communist-controlled mainland. The organizations concerned with rice production are governmental and private agencies. The governmental agencies include the Department of Agriculture and Forestry, the Food Bureau, and the Water Conservancy Bureau of the Provincial Government, the prefecture governments, the township offices, the Taiwan University and the Provincial Agricultural College. The private agencies include (1) the farmers' associations on provincial, perfectural and township levels with a small agricultural unit in nearly each village, and (2) the local hydraulic association of each water control system. The China-United States Joint Commission of Rural Reconstruction established in October 1948, by a bilateral agreement between the two governments, has given the above agencies technical assistance and and financial aid in research and impletation of the rice program. Since July 1953 the Excutive Yuan (or Cabinet) has created an Agricultural Committee under the Economic Stabilization Board to plan and coordinate agricultural programs and budgets of the agencies concerned. Dr. T. H. Shen serves as Convenor of the Committee with members consisting of representatives of JCRR, the Vice Minister and the Chairman of the Fishery Committee of Ministry of Economic Affairs, the Commissioner of the Provincial Department of Agriculture and Forestry, the Director of the Provincial Food Bureau and the Director of the Provincial Water Conservancy Bureau. Rice production is a major program of the Committee.

Since 1950 the technical knowledge of fiield workers has been improved through training classes on special subjects conducted by JCRR in cooperation with Taiwan University, the Provincial Agricultural College, the Provincial Department of Agriculture and Forestry, or the Provincial Farmers' Association. A crop improvement seminar of 60 students was conducted under the leadership of Prof. H.K. Hayes in early 1953. Modern methodology of crop breeding was taught by him. Experimental data and personal experiences on crops were presented in the seminar. Thereby coordination and cooperation in a crop breeding program among the experiment stations are being developed. Also, JCRR has sent since 1950 leading rice breeders to the U. S. A. through the technical Assistance of MSA.

Emphasis in rice production is largely laid on the increase of yield per hectare through increase of irrigation, fertilizer and manure, extending acreage of Ponlai rice, development of better varieties for yield and resistance to blast and possibly borers, and pest control by means of pesticides. All

these improvements are carried out by cooperative efforts of the agencies and the farmers concerned. The fertilizer industry is being developed largely with American aid aiming at an annual production of 421,000 metric tons for home consumption. The last, but not the least important, are the land reform program and the maintenance of a fair price of rice to stimulate the farmers' incentive to increase rice production.

OUTLINE OF COOPERATIVE RICE BREEDING AND FERTILIZER INVESTIGATIONS IN THE UNITED STATES

C. Roy Adair, in charge of Rice Investigations
U.S. Department of Agriculture

This brief report outlines the current status of rice breeding and fertilizer investigations with rice in the United States.

BREEDING

Information is presented on the current status, objectives, and some of the results of the rice investigations being conducted by the Division of Cereal Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, United States Department of Agriculture.

The Division of Cereal Crops and Diseases conducts investigations in rice breeding at Stuttgart, Ark.; Crowley, La.; Biggs, Calif.; and Beaumont, Tex., in cooperation with the State Agricultural Experiment Stations in these four States. The Division also cooperates informally in rice investigations at Belle Glade, Fla., Stoneville, Miss.; and Palmyra, Mo., with the state agricultural experiment stations in these States.

The objectives in rice breeding are to: develop early, mid-season and late maturing; short-, medium-, and long-grain varieties that are resistant to diseases, that have seedling vigor, salt and alkali tolerance, stiff straw and smooth hulls; and are adapted to the combine-drier method of harvest, produce high field and mill yields, and have the desired cooking quality.

A large number of introduced, local, and experimental varieties are tested for reaction to the most serious diseases as well as for yield and other characters listed above. Crosses and back-crosses are made in an effort to combine the desired characters in new varieties. This procedure has been continued by the Division at the four leading rice experiment stations for more than 20 years. More than 99 per cent of the rice now grown in the United States consists of varieties developed at the four rice breeding stations. Some of the varieties released, especially in the earlier years, were selected

from introductions or farm fields rather than from hybrids. New selections are grown on land with a comparatively high fertility level to study resistance to lodging. Insofar as possible, selections are tested at different levels of fertility to determine fertilizer requirements and range of adaptation.

The varieties are sown on several dates to get information on photoperiod response. A uniform group of varieties and new selections are tested at six experiment stations in six southern states to get information on the range of adaptation of the varieties. Environmental conditions are much different in California, so these uniform trials are not conducted there, although certain varietie are tested both in California and at stations in the South.

A large collection of introduced and local varieties is maintained. Each year some of these varieties are grown and evaluated for genes that may be needed in the breeding program.

Foundation seed of all recommended varieties is grown and distributed each year. The pure seed of the varieties is grown and distributed each year. The pure seed of the varieties released to commercial seed growers each year helps to maintain the quality of seed available for the commercial acreage. Arkansas, California, Louisiana, and Texas rice experiment stations have a seed distribution plan that has been operating effectively for several years, and the Delta Branch Experiment Station, Stoneville, Mississippi, is now starting a seed distribution program. The seed distribution plans are similar but not idential in the different states.

The brown leaf spot disease of rice caused by *Helminthosphorium oryzae* is important in parts of the Gulf Coast area, Breeding for resistance to this disease is concentrated in Texas. Progress is being made in isolating lines with some resistance to this fungus. Blast *(Piricularia oryzae)* often caused losses in rice grown on virgin or other very fertile soils. Varieties are available that are resistant to some of the races of this fungus but none is resistant to all races. Work is just being started to combine resistance to several races of this fungus. Studies are being conducted to determine varietal reaction to *Sclerotium oryzae*, the fungus which causes stem rot and to *Aphelenchoides oryzae*, the nematode that causes white tip. There are apparent varietal differences in reaction to these diseases, and it is hoped that adapted varieties resistant to these major diseases can be developed.

One variety, Sunbonnet, was increased in 1952 for release in 1953. This variety was selected from Bluebonnet and increased at the Rice Experiment Station, Crowley, La. It is reported to be more vigorous in the seedling stage and higher in milling quality than Bluebonnet.

A general summary of work on rice breeding in the United States was presented by H.M. Beachell at the meeting of the Rice Technical Committtee at Beaumont Tex., in January 1953. This report was published in the Rice Annual (Rice Journal, New Orleans, La.) 1953.

FERTILIZER INVESTIGATIONS

Research on fertilizers for rice is being conducted under field conditions by the rice

experiment stations at Stuttgart, Arkansas; Crowley, La.; Beaumont, Tex.; Biggs, Calif.; and Belle Glade, Fla. These researches are confined for the most part to the time, rate, and method of application of nitrogen, phosphorus, and potassium, although some tests with minor elements are conducted. Studies are also being made on the effect of different rotations and various fertilizers applied to the other crops in the rotation on the physical condition and chemical composition of the soil and on the yield of the subsequent rice crop. Soil tests are run in conjunction with many of the fertilizer and rotation experiments in an effort to improve soil testing techniques so this method will have greater usefulness in predicting fertilizer requirements for rice.

Studies are under way to determine the cause of straighthead of rice. This is a physiological disease that causes complete sterility of the diseased plants. It is known that drainage at the proper time will correct this condition but little is known of the fundamental cause or causes of the disorder. There appears to be differential varietal response to this disease. If the nature of the cause of this disease can be determined and a method worked out to produce the disease under controlled conditions, it should be possible to develop resistant varieties by breeding.

Soils in some areas where rice is grown in the United States are highly alkaline, caused by the minerals in the irrigation water. Either the high alkalinity or toxic concentration of some salts causes very low yields of rice. There seems to be a differential varietal response but no variety will produce maximum yields on these soils. Experiments are under way in an effort to determine soil treatments that can be used to correct this condition.

A general summary of the work on rice fertilizer investigations in the United States was presented by R.L. Beacher at the meeting of the Rice Technical committee at Beaumont, Tex., in January 1953. This report was published in the Rice Annual (Rice Journal, New Orleans, La.) 1953.

THE FOURTH SESSION OF THE INTERNATIONAL RICE COMMISSION AND THE NEXT MEETINGS OF ITS TWO WORKING PARTIES TO BE HELD IN TOKYO, JAPAN

4-19 October 1954

The Fourth Session of the International Rice Commission will be held at Tokyo, Japan, from 11 to 19 October 1954 and the two Working Parties of the Commission, namely the Working Party on Fertilizers and the Working Party on Rice Breeding, will meet simultaneously also in Tokyo, prior to the Fourth Session of the Com-

mission, from 4 to 10 October 1954, through the kind invitation of the government of Japan.

Letters of invitation to these meetings were sent out to all member governments of the Commission and a few international agencies over the signature of the Director-General of FAO.

This Commission now comprises the following twenty-three members: Australia, Burma, Ceylon, Cambodia, Cuba, Dominican Republic, Ecuador, Egypt, France, India, Indonesia, Italy, Japan, Korea, Mexico, Netherlands, Pakistan, Paraguay, Philippine Republic, Thailand, United Kingdom, United States of America and Vietnam.

The provisional agenda for these meetings are as follows:

INTERNATIONAL RICE COMMISSION

Fourth Session

Tokyo, Japan, 11-19 October 1954

Provisional Agenda

1. Opening of Session
2. Election of Officers
3. Adoption of Agenda
4. Progress Report by Executive Secretary on the Work of the Commission since its Third Session, including a financial statement regarding cooperative projects to which Member Nations have made special contributions.
5. Designation of Committees and Assignments of Topics to be discussed initially in Committee.
6. **Improvement of Rice Through Breeding**
   Consideration of the reports of the Fourth and Fifth Meetings of the Working Party on Rice Breeding.
7. **Improving Rice Production Through Better Fertilizing Practices**
   Consideration of the reports of the Third and Fourth Meetings of the Working Party on Fertilizers.
8. **Problems of Soil, Water and Plant Relationships in the Production of Rice**
9. **Problems of Mechanization of Rice Production**
   (a) Equipment for lifting water for irrigation
   (b) Hand and animal operated equipment and machinery
   (c) Power equipment for tilling and harvesting.
10. **Reducing Losses in Rice Through Improved Operational Methods**
    (a) Improving operational methods:—
      (i) Grading, drying, storage, handling and transportation
      (ii) Conventional milling operations and related problems
      (iii) Parboiling
    (b) Nutritional aspects:—
      (i) Effects of various operational methods on the nutritive value of rice

(ii) Extension work with reference to household preparation and consumption.

11. **Use of Rice Fields for Fish Culture**
    (a) Physical aspects
    (b) Economic aspects
12. Amendments to the Constitution of the International Rice Commission.
13. Budgetary Proposals covering any Projects requiring Special Contributions from Member Nations.
14. Other Business.
15. Time and Place of the Next Session.
16. Adoption of Report.

WORKING PARTY ON RICE BREEDING

Fifth Meeting

Tokyo, Japan, 4-10 October 1954

Provisional Agenda

1. Opening of the Meeting (jointly with the Working Party on Fertilizers).
2. Election of Chairman.
3. Adoption of Agenda.
4. Reports from countries on progress in rice breeding in 1953.
5. The International Rice Hybridization Project:
   (a) progress report from Cuttack
   (b) progress reports from countries.
6. The maintenance of genetic stocks of rice.
7. Resistance of lodging.
8. Photoperiod response.
9. Report of the Regional Liaison Officer in Rice Breeding.
10. Seed multiplication and distribution programs in Member Countries.
11.@ Problems of soil, water and plant relationships in the production of rice.
12.@ Physiological diseases of rice.
13.@ Interaction between varieties and fertilizer response.
14. Field plot technique.
15. Other business.
16. Time and place of the next meeting,
17. Consideration of draft report.

WORKING PARTY ON FERTILIZERS

Fourth Meeting

Tokyo, Japan, 4-10 October 1954

Provisional Agenda

1. Opening of the Meeting (Jointly with the Working Party on Rice Breeding).
2. Election of Chairman,
3. Adoption of Agenda.
4.@ Problems of soil, water and Plant relationships in the production of rice.

5.@ Physiological diseases of rice.
6.@ Interaction between varieties and fertilizers response.
7. Reports by countries on nitrogent phosphate and potash response curves for paddy.
8. Experimental designs for response curves.
9. Fertilizer plans and programs in Member Countries.
10. Other reports on research and experimental work.
11. Other business.
12. Time and place of the next meeting.
13. Consideration of draft report.

@—To be held jointly by the two Working Parties.

Printed and Published by

Mrs. PRAYAT JATAPUTRA at UDOM PRESS

395-401 New Road, Bangkok.

30/3/2497